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SAFETY ENFORCEMENT DIVISION
CALIFORNIA PUBLIC UTILITIES COMMISSION

CHAPTER ONE
PREPARED SUR-REPLY TESTIMONY
OF
MARGARET FELTS IN RESPONSE TO
REPLY TESTIMONY OF
TIM HOWER AND CHARLIE STINSON

San Francisco, California
June 30, 2020

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I. INTRODUCTION

The purpose of the following prepared rebuttal testimony, submitted on behalf of the California Public Utilities Commission's ("Commission") Safety Enforcement Division ("SED") is to rebut statements made by Messrs. Hower and Stinson (Hower & Stinson) regarding violations that I identified in my Opening Testimony. Specifically, the Hower and Stinson reply testimony addresses the following violations from my Opening Testimony of California Public Utilities Code Section 451 (Section 451): SoCalGas 1) did not conduct failure analyses at Aliso Canyon (Violations 1-60), 2) failed to follow its plan to check the casing of 13 wells for metal loss (Violations 61-73), 3) operated well SS-25 without a backup mechanical barrier to the production casing (Violation 77), 4) did not have a policy that required well casing wall thickness inspection and measurement (Violation 78), 5) did not appropriately understand and address groundwater (Violations 84-85), 6) did not fully cement or cathodically protect the casing against corrosion (Violation 86), 7) failed to have a continuous pressure monitoring system and thereby prevented immediate identification of the leak (Violation 87), and 8) had imprudent and unreasonable recordkeeping practices (Violations 327-329).

II. RESPONSE TO SOCALGAS 'GENERAL DISCUSSION REGARDING INDUSTRY STANDARDS

Hower & Stinson begin their Reply by stating that it is necessary to assess the relevant industry standards that applied to Aliso Canyon gas storage field (Aliso) prior to 2015. However, as shown in multiple examples in this testimony, Hower & Stinson then claim that SoCalGas exceeds industry standards that they have asserted did not exist. A draft of the Hower & Stinson testimony recognized this, stating, "Do we have a disconnect here in that we (a) state above that there really were no industry standards, and then (b) applaud SCG for meeting and exceeding industry standards?"[1] The discussion of industry standards takes many turns throughout the testimony. While I address this thread of the argument, in general, even if there were industry standards, they would not

[1] See SoCalGas Response to SED Data Request 71, I1906016_SCG_SED_DR_71_0001146.

necessarily set the standard to determine whether or not SoCalGas violated Section 451, which is the section of the PU Code that requires the Utility to operate its facilities safely. My Opening Testimony charges SoCalGas with safety violations, not violations of industry standards. If the industry had collectively set specific safety standards, my Opening Testimony would have cited to those when identifying Section 451 violations.[2] Other than for cathodic protection of wells, such standards could not be found, and Hower & Stinson confirm that none existed prior to October 2015.[3] The non-existence of industry standards does not exempt SoCalGas from operating its facilities safely to protect its employees, contractors, and the general public. Basic engineering principles and the availability of applicable technologies can be used to develop and implement safety plans and programs that ensure the safe operation and maintenance of SoCalGas ' facilities, in this case, its underground gas storage (UGS) facilities, including wells. SoCalGas has petroleum engineers, metallurgists, and other types of engineers on staff who could easily design a preventative maintenance program.[4] In fact, some of those engineers recommended preventative programs over the years that were not implemented.[5]

Hower & Stinson say that my testimony fails to identify any violation of industry standards by SoCalGas and that I demonstrated a lack of knowledge of gas industry standard practice, citing to numerous documents I provided to SoCalGas in response to a data request.[6] First, Hower & Stinson and I agree that there are no industry standards[7] (using Hower & Stinson's first definition of the term), so it would be impossible for SED

[2] For instance, in the case of cathodic protection for well casings, in this sur-Reply, I cite the National Association of Corrosion Engineers (NACE) Standard Practice, Application of Cathodic Protection for External Surfaces of Steel Well Casings, NACE SP0186-2007, published in 2007.

[3] Hower & Stinson testimony, p.3 lines 20-22 through p.4, line 1.

[4] SED DR 45 Q.7 SoCalGas identifies 17 metallurgists they employ.

[5] Examination Under Oath of Frank Selga, August 1, 2018. p.78 - 80 re recommendations to apply Cathodic protection to well casings, and Examination Under Oath of James Mansdorfer, September 13, 2018, pp. 41-43.

[6] SoCalGas DR 3.Q.7.c., Q.9.c, Q.9.b., and Q.10.c.

[7] Except for the 2007 NACE Standard for Cathodic Protection, which I cite above.

or me to identify violations of such standards.[8] Second, all violations identified in my opening testimony are direct violations of PU Code Section 451, as accurately stated by Hower & Stinson on page 1, line 9 of their reply testimony. Third, it is Hower & Stinson, not me, who are confused about the issue of standards and SED's response to SoCalGas data request number 3 (DR 3). The documents referred to by Hower & Stinson were provided in response to SoCalGas 'DR 3 Q7.c, Q.9.c, Q9.b, and Q.10.c, which request documents, not standards.[9] I provided publicly available research, case study, and technical documents per SoCalGas 'request. These documents represent information that was readily available to SoCalGas if it had wanted to use information that had been shared within the gas industry to design and implement operation and maintenance programs that would ensure the safety of its UGS facilities.

After declaring there were no industry standards, Hower & Stinson present a table in which they attempt to design a set of their own industry standards.[10] The table presented by Hower & Stinson shows no information that could be useful in relieving SoCalGas of its obligations toward safety under Section 451. Instead, it appears that they argue that since there were no industry standards, SoCalGas should not be held accountable to the safety requirement under Section 451. Hower & Stinson state that "[b]ased on the dearth of formal industry standards, we use the term "industry standards" throughout this testimony to refer to the consistent practices we have observed first-hand

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Hower & Stinson cite to API Recommended Practice 1171 ("API RP 1171"), "Functional Integrity of Natural Gas Storage in Depleted Hydrocarbon 21 Reservoirs and Aquifer Reservoirs," as the first documented gas storage industry-wide procedures that would have been considered industry standard practice.[8] Hower & Stinson take the position that prior to 2015 there were no applicable industry standards. Here, they say that for purposes of this testimony "industry standard practice" means prevailing practice within the industry.

[9] For reference, the text of DR 3 Q.7.c: "Identify and produce all DOCUMENTS, aside from the Blade Report, that support SED's contention that SoCalGas did not employ a "reasonable understanding of the groundwater depths relative to the surface casing shoe and production casing of wellSS-25" prior to the drilling of the two groundwater wells which were drilled for RCA purposes."

[10] Hower & Stinson testimony, pp. 4-6.

through our work experiences."[11] Even considering the resumes of these two experts,[12] it does not seem appropriate to designate their experience as sufficient to stand in for industry standards in an industry of about 672 UGS facilities in operation in the world, with 392 active storage facilities in the US and 62 in Canada.[13] Hower & Stinson have toured only 49 of those 672 facilities.[14] Touring a UGS facility would not make them familiar with the design, construction, operating, and maintenance history of each well in the field. Hower & Stinson admit that they do not have first-hand knowledge of how all owners and operators of underground gas storage units manage their underground storage wells, reservoirs, and related facilities.[15]

Hower & Stinson add, "As of the date of the incident there was no documented industry standard related to investigation of casing failures in gas storage operations."[16] SED quoted SoCalGas and asked Blade whether Blade agreed with this statement. Blade answered yes,[17] which is consistent with my view on the matter as well.

Hower & Stinson went on to say on page 10 that, "Blade states that "API RP 585 was developed for Pressure Equipment Integrity Incident Investigation," not gas storage well integrity management and only "presents this as an option that could be applied" to gas storage. [Footnote omitted.]. Further, Blade states that there "are no specific standards or practices related to 'failure analysis or subsequent risk assessment 'related to gas storage well casings."

To enable me to directly respond to Hower & Stinson's testimony at page 10, SED asked Blade, "What is Blade's basis for saying that API RP 585 could be applied to gas

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[11] Hower & Stinson testimony, p. 7. fn.29.

[12] Hower & Stinson testimony, pp. 42-45 – resumes of authors.

[13] Underground Gas Storage in the World -- July 2017 Status Report prepared by Sylvie Cornot-Gandolphe for CEDIGAZ http://cngascn.com/public/uploads/file/20181121/20181121100841_50998.pdf.

[14] Stinson Resume and Response to DR 90 Q.9.b, which lists 60 line items, but it appears that these only represent 49 actual USG facilities.

[15] Response to SED DR 90 Q.9.a.

[16] Hower & Stinson, testimony, p. 9.

[17] Blade Response to SED Data Request 69, Question 2, p. 17.

storage?" In response to SED's data request, Blade provided its basis for including it, as follows: "Although API 585 was not specifically for gas storage projects, Blade identified it as a solution as part of their Root Cause Analysis (RCA)."[18] Blade then explained why it believed that API RP 585 could be applied to gas storage.[19] Blade added its professional opinion that it would be a safe practice for SoCalGas to apply API RP 585 to gas storage well integrity management and the reasons for doing so.[20] To show the details of these points, Blade's data response is attached to this testimony.[21]

III. SOCALGAS FAILED TO INVESTIGATE CAUSES OF LEAKS

In Section III, Hower & Stinson lead off with the statement "[a]s discussed below, SoCalGas met or exceeded gas storage industry and industry standard practices regarding well failures and subsequent investigation into their causes."[22] Since Hower & Stinson testified in a previous paragraph that there were no applicable gas storage industry standard practices prior to 2015, the statement on page 8 must refer to Hower & Stinson's standards, as stated in their footnote 29, the standards Hower & Stinson created.[23] The question, then, is how SoCalGas "met or exceeded" Hower & Stinson's personal gas storage industry standard practices. Hower & Stinson fail to summarize an answer to this question.

Although Hower & Stinson assert that SoCalGas met or exceeded industry standards, their own discussion regarding past leaks at Aliso has no basis in industry standards. Upon SED's inquiry regarding what "gas storage industry and industry standard practices" meant, SoCalGas responded with a replacement sentence: "[t]he above-quoted testimony should say "SoCalGas met or exceeded gas storage industry

[18] Blade Response to SED Data Request 69, Question 3.a, pp. 17-18.

[19] Blade Response to SED Data Request 69, Question 3.a, pp. 17-18.

[20] Blade Response to SED Data Request 69, Questions 3b and 3c, pp. 18-19.

[21] Blade Response to SED Data Request 69.

[22] Hower & Stinson, testimony, p. 8.

[23] Hower & Stinson testimony, p. 7. fn. 29.

standard practices regarding well failures and subsequent investigations into their causes."[24] When asked what the definition of this "industry standard practices" was, SoCalGas responded:

> "gas storage industry standard practices" refers to prevailing practice within the gas storage industry based on the practices that Messrs. Hower and Stinson have knowledge of through their work experience as well as any additional information gathered by Messrs. Hower and Stinson in their review of gas storage industry standard practices as explained in response to request 4.c above.[25]

Their testimony launches into a lengthy discussion of the detection, investigation, and remediation of 60 cases of well casing leaks itemized by SED's violations 1-60.[26] Hower & Stinson immediately note that "the number of casing leaks is less than half that number, and only two of those (FF-34A and Frew 3) were of the scale where gas migrated some distance in the subsurface away from the wellbore."[27] This statement frames what must be a personal Hower & Stinson view about what an industry standard should be, rather than an actual industry standard, because it does not appear in any literature that I could find, i.e. that leaks are contingent on the distance gas has migrated in the subsurface away from the wellbore. SED asked if it is Messrs. Hower and Stinson's contention that if a well leaks, but the gas does not migrate some distance in the subsurface away from the wellbore, that well leak is insignificant and does not need to be investigated or repaired?[28] Their answer was "no."[29]

After noting that there were no existing industry standards, Hower & Stinson title Subsection A. "SoCalGas Detected, Investigated, and Remediated Well Casing Issues

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[24] SoCalGas Response to SED DR 90 Q10.a.

[25] See SoCalGas Response to SED DR 90 Q10.b. SoCalGas response to DR.90.Q4.c was ". . . Messrs. Hower and Stinson performed a review of state regulations in states with underground gas storage operations as well as a review of available documents from the American Gas Association, the American Petroleum Institute, the Society of Professional Engineers and other sources."

[26] Hower & Stinson testimony, p. 14.

[27] Hower & Stinson testimony, p. 8. l.15 – p. 9. l.1.

[28] SED DR90 Q.11.a.

[29] SoCalGas response to SED DR90 Q.11.a.

Consistent with Industry Standards,"[30] which apparently alludes to standards created by Hower & Stinson.[31]" Standards or not, SED did *not* cite SoCalGas with failing to detect, investigate and remediate well casing leaks, or "issues" as Hower & Stinson label them.[32] Violations 1-60 are based on the failure to determine the *cause* of 60 casing leaks.[33] The wording of these violations is "SoCalGas failed to perform *failure investigations*, *failure analyses* or *Root Cause Analyses* on failed Aliso Canyon wells despite more than 60 well casings experiencing leaks…"[34] SED gave SoCalGas ample opportunities to show that it sought to determine the cause of past leaks.[35] In every response, SoCalGas proved the validity of violations 1-60 by failing to produce any evidence of investigations into the causes of leaks.[36]

SoCalGas operated its wells to failure and then responded by patching them up.[37] Determining the causes of leaks would be the first step to designing a program that would

[30] Hower & Stinson testimony, p. 9.

[31] Hower & Stinson testimony, p. 7, fn.29. "Based on the dearth of formal industry standards, we use the term 'industry standards' throughout this testimony to refer to the consistent practices we have observed first-hand through our work experiences."

[32] Hower & Stinson testimony, p. 9, including footnote 33, which cites, but mischaracterizes SED Opening Testimony at page 2. The incorrect Hower & Stinson testimony says, "SoCalGas Detected, Investigated, and Remediated Well Casing Issues Consistent with Industry Standards. In its summary of violations, SED alleges 60 violations related to SoCalGas' alleged failure to adequately investigate casing "leaks".

[33] Opening Testimony, pp.7-8. Blade reviewed 124gas storage wells and identified 63 casing leaks, 29 tight spots, 4 parted casings, and 3other types of failures. (Blade Report pp. 2 and 162.)

[34] Opening Testimony p. 2, referencing SectionII.B.1.

[35] SoCalGas responses to SED DRs 11.Q.3.d, 48.Q.24, 65.Q.2, and 71.

[36] SoCalGas responses to SED DRs 11.Q.3.d, 48.Q.24, 65.Q.2, and 71.

[37] Based on my review of SoCalGas 'Aliso well files and supported by Direct Testimony of Phillip E. Baker, Underground Storage, November 2014 (2016 General Rate Case) p.PEB.5, "While we have historically managed risk at our storage facilities by relying on more traditional monitoring activities and identification of potential component failures, we believe that it is critical that we adopt a more proactive and in-depth approach. . . SoCalGas proposes to manage and approach the integrity of its storage well assets . . . in a manner consistent with the approach adopted for distribution and transmission systems." (emphasis added).

prevent future leaks and would, therefore, reduce long term costs of emergency repairs and should extend the useful life of the wells.[38]

Hower & Stinson's testimony misunderstands the nature of the 60 SED violations, and discussions of each leak identified by Blade. Therefore, Hower & Stinson's testimony misses the point and fails to show that SoCalGas properly investigated the cause of those leaks.[39] Although Hower & Stinson take time to distinguish each of the leaks underlying these violations from the cause of SS-25 well failure, once again, this exercise fails to prove that the causes of the 60 leaks were properly investigated.[40] Likewise, SoCalGas failed to show that it investigated the cause of the past leaks.[41] Therefore, the violations 1-60 should stand as valid.

IV. SOCALGAS FAILED TO TAKE REASONABLE STEPS TO PREVENT AND MEASURE CORROSION

Section IV in Hower & Stinson's testimony is titled "SoCalGas Used Reasonable Industry Practices to Prevent and Measure Corrosion,"[42] but there is no clear link to specific violations identified in their introduction. Below, I address comments by Hower & Stinson laid out under their Section IV.

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[38] See Phillip E. Baker statement in previous footnote. In the 2016 General Rate Case Application (A.14-11-004), SoCalGas presented its rational for developing such a system to be included in rates. Also based on Felts' experience using basic engineering principles of collecting relevant data for the development of operating instructions, compliance programs, safety programs and preventative maintenance programs for Amoco Oil Company, Celanese, the Department of Defense, the Department of Toxic Substances Control and several private clients.

[39] Hower & Stinson testimony, pp.13-16 bulleted paragraphs.

[40] Although the leaks themselves are a different issue than the violations, which go to SoCalGas' failure to investigate the leaks, SED asked Blade whether it agreed with Hower & Stinson's assertion on page 8 that there were only 31 leaks, approximately half of what Blade identified. Blade said it did not, corrected Hower & Stinson's testimony, and explained the basis for those corrections. This is found in Blade's response to SED Data Request 69, question 1, pages 5 through 17.

[41] Refer to fn 19 above, SoCalGas responses to SED DRs 11.Q.3.d, 48.Q.24, 65, 68, 71, 74, 75, 76 and 77.

[42] Hower & Stinson Testimony, p. 17, lines 2-3.

A. Corrosion from Groundwater Did Not Create the Holes on the 14 ¾ Inch Surface Casing

Hower and Stinson begin this section by stating that my allegations appear to be based on misunderstandings and are contradicted by the Blade report or are simply irrelevant to whether or not SoCalGas acted reasonably operating Aliso.[43]

Hower & Stinson confusingly state that my testimony assumes that the 58 holes in the surface casing were due to corrosion [and] caused the corrosion and resulting failure on the SS-25 production casing.[44] In my testimony, I state that Blade identified 58 through-wall-metal-loss holes in the surface casing of well SS-25.[45]

Hower & Stinson seem to suggest that we disagree about the 58 holes, but like Hower & Stinson, I understood from the Blade report that at least some of these 58 holes were areas of corrosion that turned into holes due to the pressure that occurred during the failure event or soon thereafter.[46] [47] In fact, there are no violations in my testimony regarding the 58 through-wall holes in the surface casing.

Violations 61-72 were for failure to follow the Company's internal 1988 plan to check casings of 12 wells (other than SS-25) for metal loss, as recommended by its own engineers. The 58 holes are examples of locations in well SS-25 that experienced corrosion before the failure.[48] Those areas of corrosion, the corrosion found in the 7-inch production casing at and near the location of failure, and SoCalGas 'failure to inspect

[43] Hower & Stinson testimony, p. 17, lines 4-7.

[44] Hower & Stinson refer to the 7 inch production casing in their heading, but then discuss the holes in the surface casing, so I assume there is a typo in the heading. Hower & Stinson Testimony p.18, subheading A.

[45] SED Opening Testimony p. 11

[46] Hower & Stinson Testimony, p. 19.

[47] Blade Main Report, p. 119.

[48] Blade Main Report, p. 3 "The gas flowing through the axial rupture on the 7 in. production casing caused an increase in pressure on the 11 3/4 in. surface casing. This caused several of the surface casing corroded regions to fail, creating holes and thus providing a pathway for gas to escape. Over 50 such holes provided a pathway for the gas to surface."

well SS-25 for metal loss as recommended by its own engineers in 1988 are the bases of the violation 73.[49]

B. Violations 83-84

Related to violations 83-85, Hower & Stinson incorrectly state that, "There Were and Are No Tools Available to Perform the Kind of Inspections SED Demands."[50] This section clarifies Hower & Stinson's confusion, and sets the record straight as to what violations 83, 84, and 85 stated.[51]

Hower & Stinson misstate violations 83 through 85, falsely characterizing my testimony as stating "[c]orrosion was not detected on SS-25 because the seven inch casing wall thickness on SS-25 had never been inspected;"[52] and also misstating that "SED's apparent premise underlying this argument is that SoCalGas failed to inspect and identify the 58 holes in the surface casing…"[53] In fact, my testimony identified violation 83 as "prevention of surface plumbing failures on SS-25 from enabling that well [SS-25] to be kept filled."[54]As Blade said in its report regarding the sixth kill attempt:

> It appeared to have killed the well, but fluid loss into the formation kept the annular fluid column from stabilizing. It is probable that continued pumping from the surface might have kept up with the fluid loss, but surface failures prevented the well from being kept filled.[55]

This issue is related specifically to well kill number 6 and has nothing to do with using tools to inspect the well for corrosion or the holes in the surface casing.

To further correct Hower & Stinson's misstatement of the violations, violation 84 was for allowing the groundwater to cause corrosion on the surface and production

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[49] SED Opening Testimony, p. 3, Table of Violations and p. 12.

[50] Hower & Stinson Testimony, p. 18.

[51] On p.1 Hower & Stinson do not list in Violation 83 in their introduction as part of their testimony

[52] Hower & Stinson testimony, p. 18.

[53] Hower & Stinson testimony, p. 18, fn 93.

[54] SED Opening Testimony, p. 4, and p. 32, fn 217, referencing Blade Report, at p. 151.

[55] Blade Main Report at p. 151.

casings of SS-25.[56] Hower & Stinson frame the violation as saying SoCalGas did not use various tools that could have been used to measure well [casing] thickness along the entire length of the casing or tubing.[57] Hower & Stinson testify that tools were not available to measure casing wall thickness during normal operation of SS-25 because the production casing was cemented in the well and could not be extracted.[58] They further state that tools such as caliper logs, cameras and casing inspection logs would not have been able to evaluate the integrity of the surface casing due to the presence of the production casing. Hower & Stinson are simply uninformed about the tools that have been available at least since 2007 to evaluate single casings and multi-level well casings for corrosion.[59]

Hower & Stinson seem to argue that the technology of the 80's and 90's was inaccurate. Therefore, results cannot be used when assessing the history of maintenance on well casings. But this is just perfect hindsight. At the time, SoCalGas used these tools and technologies, they were cutting edge and best available technology. SoCalGas chose to use these tools and technologies. Data that was collected was the best they could collect and is the historical record that we have for review and consideration. To the extent that inconsistencies and errors might be proved using today's tools and technologies, we simply have to accept the inferior quality of the earlier results, but we do not have to discount them entirely.

Finally, in the SoCalGas Reply, Abel (Chapter III) and Kitson (Chapter VI) testify that SoCalGas had a SIMP-like integrity management program as far back as 2007. If

[56] SED Opening Testimony, p. 4.

[57] Hower & Stinson testimony, p. 18, lines 14-15.

[58] Hower & Stinson testimony p. 19, lines 4-7.

[59] For instance, ARCO announced a tool in 1988 that would identify external corrosion on casings. (1988.0101.SPWLA-1988-UU-NN). In 2007, there is a report of ultrasonic logging tool that can view corrosion without removing tubing (2007.0924.SPE-108195-MS_NNN), in 2007 a paper by ConocoPhillips reports on a method for external corrosion and damage detection on outer and middle concentric strings of casings (2007.1111.SPE-108698-MS_NNN); Slumberger currently markets its electronic magnetic casing inspection tool for evaluation of multiple casing strings. (SLB.em-pipe-scanner-br).

that were true, SoCalGas had plenty of time to inspect Well SS-25 for casing integrity. But they did not.

Violation 83 should stand because Hower & Stinson fail to argue that it is not valid. Violation 84 should stand because Hower & Stinson fail to acknowledge existing technology that SoCalGas could have used to inspect Well SS-25 before the casing failed.

C. Violation 85

Violation 85 is for failure to assess the relationship between groundwater in and around the well site and surface casing.[60] Hower & Stinson incorrectly state that an "understanding of the groundwater depth is only relevant and necessary when initially drilling the well."[61] Water control agencies that also have regulatory interests related to drilling wells think otherwise. The Groundwater Protection Council published guidelines in 2012 titled "Well Construction & Groundwater Protection.[62] In their introduction, they say that surface casing must be cemented properly to protect the environment by preventing oil and gas from migrating from the well into groundwater during initial drilling and for the life of the well.[63]

Hower & Stinson go on to say that there is no conclusive evidence that groundwater or corrosion created any holes in the surface casing.[64] Actually, there is evidence that the surface casing was in contact with groundwater due to poor cement and that the external wall of the surface casing was corroded.[65] Blade found that the surface

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[60] SED Opening Testimony, p. 4.

[61] Hower & Stinson testimony, p. 19.

[62] Well Construction & Groundwater Protection, 2012, Groundwater Protection Council (of State Water Control Agencies) http://www.gwpc.org/.

[63] Well Construction & Groundwater Protection, 2012, Groundwater Protection Council (of State Water Control Agencies) http://www.gwpc.org/: "Casing strings are an important element of well completion with respect to the protection of groundwater resources because they provide for the isolation of fresh water zones and groundwater from the inside of the well. Casing is also used to transmit flowback fluids from well treatment. In this regard, surface casing is the first line of defence and production casing provides a second layer of protection for groundwater."

[64] Hower & Stinson testimony, pp. 19-20.

[65] Blade Main Report, p. 3 "The shallow groundwater above 400 ft accessed the poorly cemented 11 3/4 in. surface casing and caused localized corrosion on the surface casing OD. . . The gas flowing through

casing wall, which was corroded, finally failed under pressure caused by the October 2015 event because the edges of the holes had sharp edges.[66] Blade points out that during construction of SS-25, the well had lost circulation while cementing the 11 ¾-inch surface casing, therefore there was no indication of cement above 600 ft.[67] The 7-inch casing failure (rupture and casing parting) was above the 11 ¾-inch surface casing shoe at a depth or 892 ft.[68]

Hower & Stinson state, "Additionally, both the Blade Report and the SED testimony present a figure which shows the groundwater entering the annulus of the 7-inch production casing and the wellbore below the depth of the surface casing."[69] The image shows groundwater entering the annulus between the 7-inch production casing and the 11 ¾-inch surface casing through holes in the 11 ¾-inch surface casing. It shows groundwater that seeped through the surface casing displacing any existing mud outside of the 7-inch production casing, above and below the 11 ¾-inch surface casing shoe. The groundwater in contact with the 7-inch casing corroded the outside of the external wall of the production casing where the drilling mud from 1953 construction had leaked off.[70]

Hower & Stinson argue that because SoCalGas inherited the well drilled by Tidewater in 1953, "there really is no reason for SoCalGas to have a 'reasonable understanding of the groundwater depths relative to the surface casing shoe and

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the axial rupture on the 7 in. production casing caused an increase in pressure on the 11 3/4 in. surface casing. This caused several of the surface casing corroded regions to fail, creating holes and thus providing a pathway for gas to escape. Over 50 such holes provided a pathway for the gas to surface." Also, Blade Main Report p. 95, where Blade explains the observations it made regarding groundwater and well SS-25. Specifically: "one massive and several thinner high-permeability water layers are observed between approximately 400 and 450 ft in the Modelo formation, Several thin to moderately thick high-permeability water layers are observed between approximately 740 and 790 ft in the upper Topanga formation," and "a moderately thick high-permeability water layer between 990 and 1,000 ft is observed below the basalt, right at the 11 ¾ in. casing shoe, and several thick high-permeability water layers between 1,100 and 1,190 ft are observed below the shoe."

[66] Blade Main Report p.3, 119, and 121.

[67] Blade Main report, p. 121.

[68] Blade Main report, p. 121.

[69] Hower & Stinson testimony, p. 20 including fn. 99, citing Blade Report at 100 and SED Opening Testimony, p. 43.

[70] Blade Report, p. 43.

production casing of well SS-25'."[71] The failure of SS-25 alone provides SoCalGas good reason to have such an understanding. In addition, SoCalGas purchased the well and renovated it for gas injection and production purposes.[72] Prior to purchasing the well, it had to have reviewed the well files to understand what it was purchasing and what it would take to revamp the construction. When SoCalGas renovated the well in 1973,[73] it could have assessed the condition of the drilling mud outside of the production casing, but apparently chose not to do that, even though the tubing was pulled at the time, giving them access for the use of various tools.[74] Furthermore, years before the 2015 casing failure, a reasonable preventative maintenance program for wells should have included considering the degradation of the drilling mud outside of the casing and the potential for corrosion of casings – surface and production.[75] This is not new science or technology. Concerns about groundwater and casing corrosion issues have existed since at least 1959.[76]

Hower & Stinson note that the production casing string is cemented[77] and the surface casing is cemented,[78] creating two levels of casing. Although they do not say so,

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[71] Hower & Stinson, p. 21.

[72] AC_CPUC_SED_DR_30_0000778.1973.

[73] AC_CPUC_SED_DR_30_0000778.1973 – Well View record "5/24/73 - 6/6/73 Cleaned out to 8748', pressure tested csg, perforated for conversion to gas storage, ran tbg with gas lift valves."

[74] AC_CPUC_SED_DR_30_0000778.1973.

[75] For instance, ARCO announced a tool in 1988 that would identify external corrosion on casings.(1988.0101.SPWLA-1988-UU-NN). In 2007, there is a report of ultrasonic logging tool that can view corrosion without removing tubing (2007.0924.SPE-108195-MS_NNN), in 2007 a paper by ConocoPhillips reports on a method for external corrosion and damage detection on outer and middle concentric strings of casings (2007.1111.SPE-108698-MS_NNN); Slumberger currently markets its electronic magnetic casing inspection tool for evaluation of multiple casing strings. (SLB.em-pipe-scanner-br).

[76] 1959.0519.API-59-199.

[77] Hower & Stinson testimony, p. 24, subheading E. "The Production Casing Was Cemented Properly pursuant to Industry Standard Practices." This is another example of the disconnect from Hower & Stinson's claim on pages 3 and 4 of their testimony that "Prior to September 2015. . . there were no documented gas storage industry wide procedures that would have been considered industry standard practice."

[78] Hower & Stinson testimony, p. 21, lines 10-11.

they seem to jump back to Violation 84 with this comment, which was for allowing the groundwater to cause corrosion on the surface and production casing.[79] They also state before 2015, the casing inspection logging tools used by the gas storage industry could only evaluate a single string of pipe.[80] This statement is not true. Tools did exist to inspect multiple levels of casing.[81] [82] And, there is no reason to distinguish gas storage industry wells from any other oil & gas wells. The tools would be the same, no matter what the purpose of the well is.

Hower & Stinson state that "[b]ased on the historical data in the Aliso Canyon field, there was no reason for SoCalGas to anticipate there might be a potential problem with corrosion of the production casing at a depth above the surface casing shoe inside the annulus between the production casing and the surface casing, as occurred in the SS-25 well."[83] However, SoCalGas knew that external corrosion of any casing underground was a possibility because its personnel attended all of the NACE conferences and kept up with the development of the standards.[84] It is highly likely that SoCalGas was not aware of the extent of corrosion in its well casings because, historically, it had made no effort to inspect for corrosion.[85] After the SS-25 failure, SoCalGas inspected all of its wells within

[79] Hower & Stinson Testimony, p. 22, lines 8-18.

[80] Hower & Stinson Testimony, p. 21, lines 9-16.

[81] Brill, Thilo & Demichel, Cindy & Nichols, Edward & Bermudez, Fernando. (2011). Electromagnetic Casing Inspection Tool for Corrosion Evaluation. Society of Petroleum Engineers - International Petroleum Technology Conference 2012, IPTC 2012. 3. 10.2523/14865-MS.

[82] Johns, J. E., Cary, D. N., Dethlefs, J. C., Ellis, B. C., McConnell, M. L., & Schwartz, G. L. (2007, January 1). Locating and Repairing Casing Leaks with Tubing in Place - Ultrasonic Logging and Pressure-Activated Sealant Methods. Society of Petroleum Engineers. doi:10.2118/108195-MS (SPE - 108195-MS).

[83] Hower & Stinson Testimony, p. 21. Line 17 through p. 22, line 2.

[84] Examination Under Oath Transcript (Tr.) of Frank Selga, p. 45, line 24 to p. 46, line 21.

[85] Based on my review of well files provided by SoCalGas. Also see EUO Tr. of James Mansdorfer, p. 103, line 23 to p. 104, line 14. "Q: Okay. We understood generally from Mr. Selga that there was communication about a lack of O2 in the field, which would be a source of a threat of corrosion; and I hope I'm not misstating this, but this is our understanding of – of part of the reasoning that went into not doing cathodic protection.

A: Well, yeah, that's right. I mean if you don't have oxygen in the water, in the subsurface water, you're not going to have corrosion. And that's – I didn't get into the details, but on the very eastern part of the

a few months using its new SIMP protocol.[86] A large number of its wells were plugged and isolated as a result of these inspections, indicating that the findings mirrored those of Frew 2 (a natural gas well owned by SoCalGas), which was severely corroded.[87]

Jumping again to Violation 85, Hower & Stinson state that, "Knowledge of the hydrogeology and groundwater is *only* relevant for the design and implementation of the surface casing." (Emphasis added.) In support of this assertion, Hower & Stinson incorrectly used my deposition statement as support for their ridiculous claim.[88] The transcripts of my deposition that Hower & Stinson referenced state as follows:

> "Q: Okay. And circling back on your earlier statement, it would be necessary to have an understanding of groundwater depths for purposes of setting the surface casing, correct?
>
> A: Yes."[89]

Nowhere in that question did SoCalGas 'attorney ask me whether knowledge of hydrogeology and groundwater was *only* relevant for design and implementation of surface casing. Of course, as I stated, knowledge of groundwater is necessary to set a surface casing properly. However, SoCalGas must maintain ongoing knowledge of groundwater in the Aliso Canyon gas storage area, from the surface to the bottom of their deepest well because leaks through failed cement can cause groundwater contamination and water at any depth could cause corrosion of a well casing.[90] In a data response to SED, Blade stated it disagreed with this statement from Hower & Stinson.[91] Blade went on to say that it does not accept as true that knowledge of hydrogeology and groundwater

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field, the formation dip is different than the rest of the field, and there's – it dips to the surface, so rainwater, that carries oxygen, can get down to the wells. The rest of the field, that's not the case. And, in fact, there's – **there is no history of external corrosion on the rest of the field." (Emphasis added.)**

[86] SED Reply Testimony, p. 9. Exhibit Bates No. SED_RT_0167.

[87] SED Reply Testimony, p. 8. Exhibit Bates No. SED_RT_0161. SED asked SoCalGas for the HR Vertilog results for the wells on this list that were plugged and isolated. SoCalGas refused to provide the records on the basis that they are outside the scope of this proceeding.

[88] Hower & Stinson Testimony, p. 22, lines 10-11.

[89] Felts Depo. Tr. 254:1-5.

[90] See discussion in Section III above.

[91] Blade Response to SED Data Request 72, Question 2a, p. 5 of 7.

is irrelevant for operations and maintenance of the production casing.[92] Blade provided detailed bases for both answers.[93]

Finally, on this issue, Hower & Stinson suggest that SoCalGas can rely on the Division of Oil & Gas to provide information about groundwater and that the well was cemented to industry standards of the US gas storage industry that existed in 1953, the time of installation.[94] This statement is problematic for two reasons. First, the Division of Oil & Gas is not in the business of regularly monitoring groundwater depths, so it would be unwise to depend on this agency for current groundwater depths relative to each well casing. Second, after making the case that there are no industry standards other than the ones they created for their testimony, Hower & Stinson change their position on standards in this statement, stating that there were US gas storage industry standards in 1953 that Tidewater adhered to when the well was first installed. Hower & Stinson do not provide reference to those 1953 industry standards, and I am not aware of any.[95]

Hower & Stinson fail to provide sufficient arguments to prove that SoCalGas could not have assessed the potential for corrosion from groundwater. Violations 84 and 85 should also stand.

D. Violation 86 - Surface and Production Casing Corrosion

Hower & Stinson misstate opening testimony Violation 86, which states that SoCalGas did not have systematic practices to protect surface casing strings against external corrosion. Therefore, SoCalGas did not employ proper understanding of the consequences of corroded surface casings and uncemented production casings.

Violation 86 in my opening testimony states that SoCalGas failed to have systematic practice to protect surface casing strings against external corrosion and failed to employ proper understanding of the consequences of corroded surface casings and

[92] Blade Response to SED Data Request 72, Question 2c, pp. 5 of 7.

[93] Blade Response to SED Data Request 72, Question 2, pp. 5-6.

[94] Hower & Stinson Testimony, p. 22.

[95] Hower & Stinson Testimony, p. 22.

uncemented production casings.[96] In contrast, the title Hower & Stinson's testimony assigns to this violation is "Corrosion of the Surface Casing did not cause Corrosion in the Production Casing and the Surface Casing is not Intended as a Gas Barrier."[97]

As discussed above, Hower & Stinson did not understand my opening testimony and misunderstand Blade's report. Despite Hower & Stinson's subheading, my opening testimony does not say that corrosion of the surface casing caused corrosion in the production casing, or that the surface casing was intended to be a gas barrier.

To clarify, the basis for violation 86 was that cement along the exterior of the surface casing had failed and no longer served as a useful bond against groundwater in SS-25. The production casing was not cemented to surface. Instead, mud was left in place to serve as a barrier between formations and the exterior of the production casing. Over time, the mud barrier failed and was replaced by groundwater. This groundwater contributed to creating a perfect environment for microbial corrosion (MIC). The violation holds SoCalGas responsible for failing to use generally available industry information, as well as information that could have been obtained about its own wells to assess the relationships between well casing muds & cements, groundwater, and external corrosion of its well casings.[98]

Hower & Stinson also say "it is interesting to note that nowhere in their testimony does SED indicate what the consequences were of external corrosion of the surface casing in the SS-25 well."[99] I will clarify here, although the consequences seem obvious. The consequences of external corrosion of the surface casing occurred after the initial production casing failure and during the extent of the failure event, up until today, and will continue for some time into the future.[100] The external corrosion on the surface casing created holes, and even more holes occurred under pressure from the failure event

[96] Violation 86, p. 42 at II.B.7 of SED Opening Testimony. See also Opening Testimony, p. 4.

[97] Hower & Stinson Testimony, p. 23, line 1, subheading D.

[98] See Section III above and referenced exhibits.

[99] Hower & Stinson Testimony, p. 23, lines 6-8.

[100] Exhibit – P.13 Blade Post-Failure Analysis 2019.0531.

(release of high pressure gas when the production casing failed). Reservoir gas flowed up the 7-inch production casing (which failed due to corrosion), out of the parted casing, through the holes in the surface casing, and exited through the soil surrounding the well to the atmosphere. The consequences included:

- Uncontrolled natural gas release for 111 days;
- Seven unsuccessful kill attempts;
- Drilling a relief well;
- Blade's root Cause Analysis;
- Impacts on civilian neighbors;
- Civil suits against SoCalGas;
- Loss of use of the Aliso Reservoir for a period of time; and
- Several CPUC cases, including this Order Instituting Investigation and Order to Show Cause, with resulting demand on Commission resources.
- All of the associated costs are consequences that SED refers to in its statement,[101] and seem to have eluded Messrs. Hower & Stinson. They continue their discussion of this violation in Subsection E.

E. Hower & Stinson Misstate Opening Testimony Violation 86 which states that SoCalGas Failed to Have a Systematic Practice to Inspect External Casing Cement and Mud Bonds To Ensure Safe Operations

Subsection E of Hower & Stinson seems to make another argument based upon a misstatement of violation 86. Opening Testimony violation 86 states that SoCalGas failed to have systematic practices to protect surface casing strings against external corrosion and failure to employ proper understanding of the consequences of corroded surface casings and uncemented production casings.[102] Hower & Stinson shorten this 451 violation to "did not understand the consequences of uncemented production casings" and then title their subsection E to say that, "The Production Casing was Cemented Properly

[101] SED Opening Testimony, p. 47.

[102] SED Opening Testimony, p. 4.

pursuant to Industry Standard Practices".[103] [104] Once again, Hower & Stinson refer to industry standard practices that they previously said did not exist. I agree that SS-25 was installed in 1953 using the well design that was typical in the industry at the time for drilling and completing oil & gas production wells. However, in 1973, SoCalGas renovated the well knowing that the production casing would be put into different service, exposed regularly to the high pressures of injected and produced natural gas. They also should have known the depths of water from geological surveys. Still, SoCalGas took no steps during renovation to cement the casing to surface or to inspect the condition of the original cement bond and drilling mud after 20 years.[105] Over the life of the well after 1973 (another 42 years), SoCalGas failed to perform surveys of the casing to determine the condition of the cement bond and mud seal between the casing and formations. SoCalGas made no effort to determine if corrosion was occurring.[106] Therefore, SoCalGas failed to take steps to make the SS-25 well safe for continued operation, which is a 451 violation. Hower & Stinson continue their discussion of violation 86 in subsection F.

F. There was an Industry Standard for Cathodic Protection, and Findings by Blade and SoCalGas Indicate SS-25 was Significantly Corroded

Hower & Stinson address the final piece of violation 86 in their subsection F. Again, rather than capture the entire violation, they quote only a part of it, stating, "SED alleges that '[c]athodic protection systems are commonly used to protect pipelines from corrosion and goes on to imply that SoCalGas is in violation of Section 451 for not employing cathodic protection on SS-25."[107] The complete statement of violation 86 is

[103] Hower & Stinson Testimony, p. 24.

[104] The point in time suggested by this statement would have been in 1953, when tidewater completed SS-25.

[105] AC_CPUC_SED_DR_30_0000778.1973 – Well View record "5/24/73 - 6/6/73 Cleaned out to 8748', pressure tested csg, perforated for conversion to gas storage, ran tbg with gas lift valves."

[106] Based on review of SS-25 well files provided by SoCalGas.

[107] Hower & Stinson Testimony, p. 25.

that "SoCalGas failed to have systematic practice to protect surface casing strings against external corrosion and failed to employ proper understanding of the consequences of corroded surface casings and uncemented production casings."[108]

Regarding the part of violation 86 that Hower & Stinson address in subsection F, they argue that "[C]athodic protection is not the industry standard for gas storage wells."[109] Apparently, Hower & Stinson are using their personally devised industry standards to conclude that cathodic protection is not an industry standard for gas storage wells, because there is a standard in this case that has been around since at least 2001.[110] There is no point in distinguishing gas storage wells from any other wells that have steel casings. In fact, SS-25 was originally an oil well, and the original steel casing was still in use when it failed from corrosion. Cathodic protection has been used in the oil & gas industry to protect well casings since 1959.[111] The NACE standard titled "Standard Practice – Application of Cathodic Protection for External Surfaces of Steel Well Casings" was published in 2007.[112] In fact, SoCalGas has been using cathodic protection at least since 1992, as indicated by an internal memo discussing applying cathodic protection to well FF-34A at Aliso.[113] SoCalGas has installed cathodic protection on wells in all of its UGS areas.[114] Hower & Stinson are simply misinformed.

Hower & Stinson point out that Blade did not find a "hot spot" of casing corrosion around SS-25.[115] By "hot spot" I assume they are talking about an area within Aliso that had more casing corrosion than other areas. But this finding was likely because SoCalGas

[108] Opening Testimony, pp. 4 and 45.

[109] Hower & Stinson Testimony, p. 25.

[110] NACE Standard Practice SP0186-2007 titled "Application of Cathodic Protection of External Surfaces of Well Casings" was formerly RP0186-2001.

[111] 1959.0519.API-59-199, presentation by Standard Oil of California.

[112] SED_RT_0029 – SED_RT_0056.

[113] AC_CPUC_0022178.FF34-A.CP.

[114] Selga, p.30, lines 13-16 "there is cathodic protection applied to the well casings at Goleta, Honor Rancho, and then some at Aliso Canyon."

[115] Hower & Stinson Testimony, p. 26, lines 4-13.

had only performed one model SIMP investigation that showed the extent of corrosion before failure[116] by the time SS-25 failed.[117] In 2016, SoCalGas investigations of the other Aliso wells led to immediately closing of many of them.[118] SoCalGas '2016 investigations suggests findings that might have led Blade to conclude that corrosion was far more common than SoCalGas data led them to believe. Blade found that SS-25 had external corrosion on the surface casing and the production casing, something SoCalGas was apparently unaware of prior to the casing failure.[119] A multi-caliper log of the SS-25 production casing performed in January 2016 shows wall loss up to 39%, which can significantly weaken the casing.[120] Despite logistical issues cited by Hower & Stinson, SoCalGas could have considered installing cathodic protection on SS-25 and other wells to combat corrosion. SoCalGas' own employees believe it could have been done.[121]

Hower & Stinson's arguments regarding cathodic protection, the final piece of violation 86, fail. Therefore, violation 86 should stand.

V. SOCAL GAS DID NOT IMPLEMENT ITS SIMP PROGRAM UNTIL AFTER THE SS-25 WELL FAILURE

In Section V of their testimony, titled "SoCalGas Had Wellbore Integrity Management Program Before The Incident That Met Or Exceeded Industry Standard Practices," Hower & Stinson claim that violations 74, 75, and 78 are unfounded.[122] Once again, Hower & Stinson misstate violation 74 to reach their conclusion. Here is the comparison showing Hower & Stinson's misuse of facts, and what the violations actually say.

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[116] Well Frew 2. SED Reply Testimony, pp. 8-10.

[117] 2016.1001.AC_CPUC_0014708.SIMP.10.2016.Status.

[118] 2016.1001.AC_CPUC_0014708.SIMP.10.2016.Status.

[119] Blade Main Report, p. 5.

[120] 2016.0121.I1906016_SCG_SED_DR_67_0000004.SS-25.wall.loss.

[121] Examination Under Oath of Frank Selga, August 1, 2018. p.78 - 80 re recommendations to apply Cathodic protection to well casings, and Examination Under Oath of James Mansdorfer, September 13, 2018, pp. 41-43.

[122] Hower & Stinson Testimony, p. 28, lines 10-12.

According to Hower & Stinson: "SED's Opening Testimony alleges, 'SoCalGas did not *have* any form of risk assessment focused on wellbore integrity management, including lack of assessment of qualitative probability and consequence of production casing leaks or failures." SoCalGas footnote 113 for this passage references SED Opening testimony on page 12, but Hower & Stinson do not make clear which exact violation they are talking about. However, the closest violation of the three to which SoCalGas refers in this passage (74, 75, and 78) is violation 74. In contrast to Hower & Stinson's statement, SED Opening Testimony violation 74 states, "Failure to *implement* a risk or integrity management program for Aliso Canyon storage facility (Aliso)." (Emphasis added.) Violation 74 on the table of page four of Opening Testimony references to section II.B.2.a, and that section is found on page 13; not page 12.

Again without clearly stating which exact violation they are talking about, Hower & Stinson say that "SED further criticizes SoCalGas for not initiating a storage integrity management program in 2009, even though such a program was recommended by Mr. James Mansdorfer, who was the Storage Engineering Manager at the time."[123] Hower & Stinson then claim to have reviewed SoCalGas records and determined that SoCalGas had a wellbore integrity management program as early as 2007.[124] They did not say that SoCalGas *implemented* the integrity management program. Among violations 74, 75, and 78 referenced in this passage, violation 75 seems to be closest. This one is for SoCalGas ' failure to detect corrosion on well SS-25 resulting in part from lack of risk assessment at Aliso. Other than statements by Hower & Stinson and Kitson, the testimony provides no evidence in the documents provided to SED in response to discovery questions that prove there actually was a SoCalGas wellbore integrity management program prior to 2016, and certainly not back to 2007.

Due to this lack of evidence in Hower & Stinson's testimony, I found that SoCalGas witness, Ms. Amy Kitson, also made a similar assertion on page 3 of her

[123] Hower & Stinson Testimony, p. 28, lines 6-9.

[124] Hower & Stinson Testimony, p. 28, lines 10-16.

testimony. She claimed that in 2007 SoCalGas began a well integrity program to inspect, evaluate, and mitigate downhole integrity issues. SED requested that SoCalGas provide the documentation supporting that statement.[125] In response, SoCalGas stated, "SoCalGas interprets this request to seek an example supporting the statements quoted from Chapter VI Prepared Reply Testimony of Amy Kitson on Behalf of Southern California Gas Company. For an example well, please see electronic documents with Bates range:

> I1906016_SCG_SED_DR_59_0000001 through
> I1906016_SCG_SED_DR_59_ 0000003."

This "example" consisted of one document that SoCalGas provided to DOGGR entitled, "History of Oil or Gas Well". It shows what appears to be operations and maintenance efforts on one well, Fernando Fee 32E, from June 8, 2007 to May 18, 2008,"[126] and a document that has the words, "Ultrasonic Imager Gama Ray-Neutron" also on Fernando Fee 32E, dated June 2, 2007.[127] These documents do not show anything that would indicate that SoCalGas had a SIMP-like integrity management program in 2007. SoCalGas did not provide a standard for the claimed program.

In 2014, SoCalGas began the process of designing the SIMP Program for the purposes of requesting funding in the 2016 Rate Case. SoCalGas did run some trial investigations in a pilot program to select the tools they wanted to use for the SIMP program and, in the course of that process, ran the tools on FREW 2, which was found to be seriously corroded.[128]

Prior to these pilot SIMP investigations, SoCalGas ran limited surveys on wells when the tubing was pulled for other purposes. These activities were not part of a planned integrity management program to inspect Aliso wells and had occurred on various wells

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[125] SED Data Request 59, pdf p. 2, Question 1a.

[126] SoCalGas Response to SED Data Request 59, Question 1a, I1906016_SCG_SED_DR_59_0000001 to 0000002.

[127] SoCalGas Response to SED Data Request 59, Question 1a, I1906016_SCG_SED_DR_59_0000003.

[128] Well Frew 2. SED Reply Testimony, pp. 8-10.

since SoCalGas acquired the Aliso UGS area. Those actions were reactive and implemented only when a well was down for some specific maintenance or because a leak was indicated by surveys or well behavior, and the leak was to be repaired.[129] SoCalGas has provided no evidence of a formal risk assessment or integrity management program. Had there been such a program in place, SoCalGas would have identified the problems with SS-25 before it failed. Hower & Stinson cite to a "Replace & Inspect" program, which makes no sense in title alone. This seems to suggest that when SoCalGas replaces casing, it then inspects the casing. Maybe they mean Inspect & Replace. They mention what would be routine inspections of well hardware such as wellhead valves, well tubing and packer, not casings. However, there is no violation in my Opening Testimony regarding the maintenance of the internal components of wells.

I acknowledge that the SoCalGas SIMP model investigation of FREW 2 occurred just prior to the 2015 failure of well SS-25. SoCalGas personnel were just beginning to draft the SIMP Plan in December 2014.[130] Actions under the new SIMP program did not begin until 2016. In fact, SoCalGas management took steps to prioritize and speed up implementation in December 2015, during the SS-25 failure event.[131] Nevertheless, it took SoCalGas 42 years to develop a plan to inspect wells that were 20 years old when they purchased Aliso. During that time, all of the Aliso wells were subject to corrosion and were deteriorating, as shown by the number of wells plugged and isolated after the 2016 SIMP investigations. [132]

Finally, violation 78 is for the operation of Aliso without internal policies that required well casing wall thickness inspection and measurement. In a short statement

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[129] Direct Testimony of Phillip E. Baker, Underground Storage, November 2014 (2016 General Rate Case) p.PEB.5, "While we have historically managed risk at our storage facilities by relying on more traditional monitoring activities and identification of potential component failures, we believe that it is critical that we adopt a more proactive and in-depth approach. . . SoCalGas proposes to manage and approach the integrity of its storage well assets . . . in a manner consistent with the approach adopted for distribution and transmission systems." (emphasis added)

[130] I1906016_SCG_SED_DR_59_0000058.SIMP.

[131] Pgs.from.2018.0824.EUO-04_SELGA_0000001-0000923.

[132] 2016.1001.AC_CPUC_0014708.SIMP.10.2016.Status.

directed at violation 78, Hower & Stinson point out that California is one of several states requiring periodic mechanical integrity testing on gas storage wells with tubing and packer completion.[133] Hower & Stinson then reason that since other States do not have this requirement, and by following DOGGR requirements, SoCalGas exceeded national standards by conducting annual temperature surveys on all Aliso Canyon storage wells. Recall, however, that Hower & Stinson originally argued that there are no industry standards, other than the ones they personally designed specifically for their testimony and after the incident occurred.[134] Following DOGGR requirements is not an option for SoCalGas; they are required to do so. Despite following DOGGR requirements, which only call for annual temperature surveys, SoCalGas should know from its own experiences with temperature surveys that the data can be severely erroneous and misleading. For example, on Well FREW 3, temperature and noise survey results showed two casing leaks at 1000 ft and 1060 ft. After down-hole inspections, a casing leak was found at 3240 ft and repaired.[135] A 2000 foot difference between the depths of two leaks detected and the one confirmed is a significant error in initial temperature survey results.

Hower & Stinson fail to provide sufficient arguments to prove SoCalGas acted reasonably. Therefore, violations 74, 75, and 78 should stand.

VI. SOCALGAS OPERATED WELLS WITHOUT DUAL BARRIERS KNOWING THAT THIS WAS AN UNSAFE PRACTICE FOR ALISO GAS STORAGE WELLS

Violation 77 is for the operation of well SS-25 without backup mechanical barrier to 7-inch production casing.[136] As shown here, Hower & Stinson failed to prove that SoCalGas operated SS-25 safely without a dual barrier. Hower & Stinson title their Section VI "Dual Mechanical Barriers are not Industry Standard and Single Barrier Well

[133] Hower & Stinson, Testimony, p. 30, lines 10-12.

[134] Hower & Stinson Testimony, p. 7, fn. 29.

[135] SCG DR 83, FREW 3.

[136] Opening Testimony of Margaret Felts, p. 3.

Completions are Industry Standard." Of course, this title has no bearing on violation 77, which is a 451 safety violation.

I assume it is Hower & Stinson's personal industry standards that they rely on to make these statements since they have said that there are no industry standards other than those they devised.[137]

Hower & Stinson cite to the *Underground Natural Gas Storage – Integrity & Safe Operations* ("JITF Report"), report as a source of their standard, quoting: "[o]perators have designed and installed a number of different well completions depending on their historical experiences, practices, and site-specific conditions. A common well completion case referenced herein contains production casing without tubing." The JITF Report goes on to state that "10-25 percent of natural gas storage wells have a full tubing string set into an 8 isolation packer."[138] Aliso wells were all completed with tubing, therefore, Hower & Stinson conclude by this quote that Aliso Canyon's single barrier well completion (completed with tubing set in a packer) is consistent with the 'industry standard' of approximately 87% of all gas storage wells in operation in the US. But Hower & Stinson fail to note that SS-25, as well as most of the Aliso wells, were used for injection and production of high pressure gas via the 7-inch casing, not just the tubing, which is not common for any single barrier well.[139] In fact there were holes in the bottom of well SS-25 that connected the casing with the tubing, so both tubing and casing operated at the same pressure all of the time.[140] For most wells the 7 inch casing would provide a second barrier to the tubing. [141] In fact, after the SS-25 well incident, SoCalGas

[137] Hower & Stinson Testimony, p. 7, fn. 29.

[138] Hower & Stinson Testimony, p. 31, lines 3-9.

[139] AC_CPUC_SED_DR_27_0000117.

[140] SED SCG - DR 89.cross-over.ports.

[141] How_a_Well_is_Built-1 From IADC web site: http://drillingmatters.iadc.org/wp-content/uploads/2016/09/How_a_Well_is_Built-1.pdf.

stopped using casings for injection and production, presumably because it was not a safe practice.[142]

Hower & Stinson fail to prove that SoCalGas was operating SS-25 safely without a dual barrier. Therefore, violation 77 should stand.

VII. SOCALGAS 'LACKED INTERNAL POLICIES THAT REQUIRED WELL CASING WALL THICKNESS INSPECTION AND MEASUREMENT.

Violation 78 is for Aliso's operation without internal policies that required well casing wall thickness inspection and measurement.[143] Hower & Stinson's reply testimony to this is flawed for several reasons.

First, Hower & Stinson state, "Further, as already noted, the SoCalGas monitoring program met and exceeded industry standards."[144] As stated numerous times above, Hower & Stinson say that there are no industry standards. Therefore it would be impossible for SoCalGas to comply with them.

Second, Hower & Stinson say that "DOGGR approved SoCalGas's monitoring program as being in regulatory compliance."[145] DOGGR required temperature surveys, which SoCalGas adhered to, but have nothing to do with the measurement of wall thickness. SoCalGas measured wall thickness on occasion in some wells, but it lacked any program that would direct routine inspection and measurement of wall thickness for the purposes of preventative maintenance. The multi-finger Caliper Log performed in January 2016 on SS-25 shows the type of information SoCalGas could have had on Aliso wells if it had a program for such investigations.[146] High Resolution (HR) Vertilog can

[142] Pages 56-57 EUO-08.DR01.01.JM0400-JM0555.

[143] Opening Testimony of Margaret Felts, p. 3, 25, fn 153, citing Blade Report, p. 5.

[144] Hower & Stinson testimony, p. 32, lines 13 to 14.

[145] Hower & Stinson testimony, p. 32, lines 12 to 13.

[146] 2016.0121.I1906016_SCG_SED_DR_67_0000004.SS-25.wall.loss.

provide even more detail regarding the condition of the casing.[147] SoCalGas provided an example of how to read HR Vertilog images (in part).[148]

Third, Hower & Stinson say that "SED's testimony creates the inference that SoCalGas could have, and should have, done better than simply running temperature surveys and periodic noise logs." Hower & Stinson then claim that this criticism is myopic, ignoring lessons learned by industry over more than 60 years.[149] But, as noted above, SoCalGas already had proof from well Frew 3 that reliance on temperature surveys was not the best option for maintaining safe well conditions.[150] In that case, a temperature survey on Frew 3 indicated two leaks that turned out to be one leak about 2000 feet deeper in the well than the survey indicated.[151]

Fourth, SoCalGas has hundreds of Standards, yet, it failed to write one for the very basic survey that could have made their wells safe. Hower & Stinson also argue that running a casing inspection log in a well such as SS-25 requires conducting a workover of the well.[152] This requirement is a non-issue for SoCalGas because they do this all of the time. SoCalGas has a standard for the routine killing of wells for maintenance.[153] This is part of the process required to maintain wells and SoCalGas and its contractors are competent to do this. In addition, when SS-25 failed, SoCalGas immediately recognized the importance of inspecting all of the Aliso wells. They managed to inspect them under their new SIMP program within a year after the SS-25 incident,[154] something that could have been spread out over many years if SoCalGas had implemented a program for inspection and measurement of wall thickness years ago to protect the integrity of its

[147] I1906016_SCG_SED_DR_59_0000060.BH.Vertilog.

[148] DR25.01 SCG files_0000001-0001537 p.793.Corrosion.

[149] Hower & Stinson Testimony, p. 32.

[150] DR 83, Well Frew 3.

[151] DR 83, Well Frew 3.

[152] Hower & Stinson Testimony, p. 32, lines 20, 33, line 1.

[153] Well Standards DR 17.Well.Kills.

[154] Pgs.from.2018.0824.EUO-04_SELGA_0000001-0000923.

wells and to provide safe systems. Hower & Stinson fail to show that SoCalGas 'failure to devise and implement a plan was a safe approach. Therefore violation 78 should stand.

VIII. FAILURE TO HAVE CONTINUOUS PRESSURE MONITORING SYSTEM FOR WELL SS-25.

Violation 87 is the failure to have continuous pressure monitoring system for well surveillance because it prevented an immediate identification of the SS-25 leak and accurate estimation of the gas flow rate.[155] Hower & Stinson claim, "SED's testimony regarding real time pressure monitoring ("RTPM") is unclear. At deposition, SED's witness clarified that the reason RTPM was important was that it could have enabled SoCalGas to identify and remediate the leak at SS-25, which she believes had been present for years, at an earlier point in time."[156] As shown by the reference of this violation to the Blade Report, this violation is based on Blade's analysis, not my deposition.

At the time of the event, SoCalGas reported that there were "no anomalous pressure readings" from the previous day, which was not helpful in analyzing the immediate problem on SS-25 when gas was detected.[157] As stated in my opening testimony and the Blade Report, the lack of real-time pressure measurements prevented the immediate identification of the SS-25 7-inch casing failure.[158] As also noted by Blade, the constant monitoring of the tubing, production casing, and surface casing pressures will provide better insight into operational deviations in all wells.[159] If this type of system had been installed on SS-25, it would have provided insight into the time of the leak, the opportunity to shut in the well immediately, size of the leak, and the extent of the problem.[160] Furthermore, the information could have been used during well-control

[155] Opening Testimony of Margaret Felts, pp. 4. 47 fn. 348, citing Blade Report at p. 5.

[156] Hower & Stinson, p. 35, line 21 - p. 36, line 1.

[157] Pages.113-115.DR33.01 SCG files 0000001-0163.

[158] Opening Testimony of Margaret Felts, p 47 Section 8 and Blade Report at p. 5.

[159] Blade Report at p. 233.

[160] Blade Report at p. 233.

efforts improving the chances of early success.[161] I agree with Blade and adopted their analysis, which is based on sound engineering principles.

One of the first things SoCalGas did in response to the incident was to install real-time pressure monitoring on SS-25.[162] Real-time pressure information was clearly deemed by SoCalGas and Boot & Coots to be critical to well kill efforts.

Information gathered by SoCalGas during the incident supports this violation because it shows an unusual variance of pressure readings from normal.[163] If SoCalGas had real-time pressure monitoring, prior to the casing failure, they would have seen normal operating casing and tubing pressures of 2700 psig, and the surface casing should be zero. Then, as the leak evolved, pressures would have changed and, presumably, SoCalGas personnel who monitor instrument readings would have noticed something was wrong. By the time the casing had already failed, on October 23, 2015, pressures were 270 psig on the casing, 1700 psig on the tubing, and 140 psig on the surface casing.[164] If the pressures had been continuously monitored, there would be no debate as to how the casing failure progressed.[165] Pressure instruments provide vital information when a system is failing, allowing personnel to take immediate steps to shut in the system. Because SoCalGas did not have the instruments in place, we will never know what SoCalGas could have known before the pipe failed, or if that information would have caused them to shut in the well prior to failure, averting the entire incident.

[161] Blade Report at p. 233.

[162] Find reference. SoCalGas was in the process of installing these pressure monitoring systems throughout their UGS units, but had not gotten to Aliso yet.

[163] AC_CPUC_SED_DR_30_0000776.event.pressures.

[164] AC_CPUC_SED_DR_30_0000776.event.pressures.

[165] Example of chart: AC_CPUC_SED_DR_17_0001784.Surface.Casing.Pressure.

A. Whether or not there is an industry standard for real-time pressure monitoring is irrelevant.

Hower & Stinson state that, "real-time pressure monitoring systems are not industry standard in gas storage fields."[166] SoCalGas is familiar with Supervisory Control and Data Acquisition (SCADA) systems common in natural gas pipelines.[167] So, speculation about whether or not industry standards exist is pointless. SoCalGas must know how useful real-time data is and how it can make operations of their facilities safer because they use it. Hower & Stinson even admit that SoCalGas was installing real-time pressure monitoring on its wells at the time of the SS-25 incident.[168] SoCalGas just had not managed to get the instrumentation installed on the Aliso wells before SS-25 failed. SoCalGas installed the instrumentation on SS-25 on October 28, 2015.[169]

B. Blade's findings regarding real-time pressure monitoring are correct and relevant

Hower & Stinson take exception to Blade's findings quoted in SED's testimony, as follows:

- "The lack of real-time pressure measurements prevented the immediate identification of the SS-25 7-inch casing failure."[170]
- [i]f this type of system had been installed on SS-25, it would have provided insight into the time of the leak, the opportunity to shut in the well immediately, size of the leak, and the extent of the problem."[171]

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[166] Hower & Stinson testimony, p. 36, Section VIII, heading A. They qualify that installing SCADA on existing gas storage wells was not an industry standard practice in the U.S. gas storage industry in October 2015.

[167] 2009 Biennial Cost Allocation Proceeding A.08-02-001. SoCalGas Response to California Gas Corporation (SCGC) data request, Q 7.1.1. Question was to provide the name of each major organization unit making up the Pipeline System and Planning Department that conducts activities considered to be those of the System Operator. The first organization listed by SoCalGas is "SCADA – maintain the primary data acquisition & control (SCADA) system for gas transmission and storage system."

[168] P. 37, lines 16-18.

[169] AC_CPUC_SED_DR_17_0001726.pressure.transmitter.

[170] Hower & Stinson Testimony, p. 38, lines 5-8.

[171] Ibid.

Hower & Stinson call these findings incorrect and irrelevant.[172] They believe a few hours difference in the initial identification of the gas leak and the closing of the well would have made absolutely no difference to the actions and outcome at the well SS-25.[173] But they provide no evidence to support this statement. As mentioned above, we will never know what SoCalGas could have known between the time of the day-before pressure readings and the time of the incident.

Hower & Stinson provide no evidence to support their claims that real-time pressure monitoring should not have been installed on SS-25 prior to the incident. Thus, violation 87 should stand.

IX. SOCALGAS ADMITS THAT IT DID NOT PROVIDE ORGANIZED WELL FILES TO SED FOR REVIEW

Violations 327 through 329 say that SoCalGas had imprudent and unreasonable recordkeeping practices. Hower & Stinson testify that they believe the well files are well organized and contain appropriate and necessary information.[174] I do not doubt Hower & Stinson believe this, but it is highly likely that they were not present in late 2015 to view well files at Aliso. I will address the condition of the well files in Chapter VII.

When I first became involved in this case as a consultant, the first file I had access to and reviewed was the first SS-25 well file provided to SED. It contained pdfs – one for each page in the file – of all pages in the SS-25, SS-25A, and SS-25B well files. These sets were mixed together. The pages were in no particular order and not collected in any groupings. There were no obvious folders. I based my opening testimony on this file. SED asked SoCalGas if the files were incomplete, inaccurate, or otherwise not reflective of the actual well files. SoCalGas responded that they were not incomplete or inaccurate. To the third question, they said "The electronic well files provided to SED are exact copies of the documents in the hard-copy well files. However, it seems the organization of the hard-copy well files (including that the files had pockets, fasteners, and additional

[172] Hower & Stinson, p. 38, lines 9-10.

[173] Hower & Stinson Testimony, pp. 38-39.

[174] Hower and Stinson Testimony, p. 40, lines 14-16.

file folders) may not have been captured in the electronic well files provided to SED, as reflected in SED's Opening Testimony (SED Opening Testimony at page 72: "The Well File for SS-25 is not kept in any particular order.")[175]

In 2020, when I was in Los Angeles, I initially asked to view the Aliso files. But, after thinking about this, I realized that SoCalGas had five years to put the files in order and that the files that were scanned in late 2015 or January 2016 were more likely to accurately represent the condition of the files during the SS-25 failure event.

X. ADDITIONAL CLARIFICATIONS FROM BLADE IN RESPONSE TO HOWER & STINSON'S TESTIMONY

Hower & Stinson make a number of assertions about Blade's RCA. To clarify the record, SED data requested Blade to give Blade an opportunity to respond to Hower & Stinson's assertions. I provide brief descriptions of Hower & Stinson's assertions, and Blade's responses to help clarify the record. These descriptions are merely summaries, but references to the details of Blade's data responses that support these summaries are provided as Exhibits with this testimony.

- Assertion 1: Hower & Stinson claim that SED and Blade over counted leaks. Blade and I both disagree and maintain that the count number is accurate.

In Hower & Stinson's words,

> Moreover, SED and Blade mischaracterize the 60 or 63 well casing issues of varying cause and degree as "leaks". [Footnote omitted] Indeed, the number of actual casing leaks is less than half that number, and only two of those (FF‐34A and Frew 3) were of the scale where gas migrated some distance in the subsurface away from the wellbore.[176] . . .
>
> There were 31 casing "leaks" documented by Blade which were not leaks at all, were double or triple counted leaks from the same event, or did not occur during the conversion of the field to underground gas storage, initial drilling of a new storage well, routine casing

[175] SoCalGas Response to SED DR 77.

[176] Hower & Stinson Testimony, p. 8.

> repairs of stage collars, and a water shut‐off test. Further, only two of the actual casing leaks documented by Blade (FF‐34A and Frew 3) involved situations where gas was known to have mitigated some distance in the subsurface away from the wellbore.[177]

SED asked Blade if Blade disagreed with any part of this statement. Blade stated that it did indeed disagree with the statement, and offered a correction to the statement as shown below. There were 31 casing "leaks" documented by Blade which were not leaks at all, were double or triple counted leaks from the same event, ~~or did not occur~~ occurred during the conversion of the field to underground gas storage, initial drilling of a new storage well, routine casing repairs of stage collars, and a water shut‐off test.

Blade then explained in detail why its initial count of leaks at Aliso Canyon natural gas storage facility was accurate.[178] Blade's answer addresses and responds to each bullet point in Hower & Stinson's testimony, pages 13-16, under the sentence on page 13 where Hower & Stinson assert, "Blade's list of 63 relevant casing failures incorrectly includes the following:"[179] SED continues to agree with Blade's observed leak count.

- Assertion 2: Hower & Stinson state on pages 11 and 12,

> It is also critical to note that of the casing failures documented by Blade, which provide the basis for SED's alleged violations, there was no pattern identified that would have led SoCalGas staff to determine that there was any sort of systemic issue that would have indicated that an SS25 type failure was likely. According to Blade:
>
> Wells with casing failures were distributed throughout the Aliso Canyon Field. Nothing seems unusual regarding the casing failures

[177] Hower & Stinson testimony, p. 16.

[178] Blade Response to SED Data Request 69, Question 1, June 9, 2020, pp. 5-17.

[179] Blade's responses to Hower & Stinson's bullet points can be found in Blade Response to SED Data Request 69, Question 1, pp. 8 through 17.

> near SS-25 when comparing them to casing failures in the rest of the field. The depths of casing failures ranged from the wellhead to below 8,000 feet, and no general pattern is apparent [Footnote omitted] [Emphasis removed from Hower & Stinson testimony, as no emphasis in original.)
>
> Further, Blade stated that '52% of the leaks were between surface and 4,000 ft. with no trend of leak count vs. depth." [Footnote omitted]. Finally, Blade stated that '[t]he failure and casing leak rate for the gas storage wells is around 50%, implying that well age does not correlated with casing failures. [Footnote omitted.]

SED asked Blade a data request about its views regarding this passage from Hower & Stinson's testimony.In response, Blade stated,

> As described in the Blade reports, no patterns of casing failures were identified, based on the data available. However, it is not known if a pattern might have been identified if failure investigations had been undertaken." Blade added that, "A failure investigation of casing OD corrosion in other wells might have directed attention to SS-25 and other similar wells. As was stated in Section 5.2.2, page 216 in Blade's Main Report, *"Despite the number of casing failures that had occurred in the field, no failure analysis or subsequent risk assessment was done that may have led to an awareness that corrosion was a potential problem."* (Emphasis in original.)[180]

- Assertion 3: Hower & Stinson stated on page 22 that, "Knowledge of the hydrogeology and groundwater is only relevant for the design and implementation of the surface casing."

SED asked whether Blade agreed with this. Blade stated it did not agree with this view, reasoning in part that, "The corrosion resulting from groundwater outside the production casing represented a threat to the integrity of the production casing. In addition, many of the Aliso Canyon wells had uncemented production casing in the vicinity of the groundwater."[181]

[180] Blade Response to SED Data Request 69, Question 2, June 9, 2020, p. 19.

[181] Blade Response to SED Data Request 72, Question 1, June 10, 2020, p. 5.

Also in response to a request from SED regarding this passage from Hower & Stinson, Blade answered that it does not accept as true that knowledge of hydrogeology and groundwater is irrelevant for operations and maintenance of: 1) The production casing that is at the same depth and covered by the surface casing; or 2) The production casing that is at lower depths and not covered by the surface casing.[182]

[182] Blade Response to SED Data Request 72, Question 1, June 10, 2020, p. 5.